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[54] **LUBRICATING SYSTEM FOR VERTICAL SHAFT ENGINE**

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[52] **U.S. Cl.** .... **123/196 W**; 123/196 R; 184/11.1; 184/13.1

[58] **Field of Search** .... 123/196 R, 196 W; 184/11.1, 13.1

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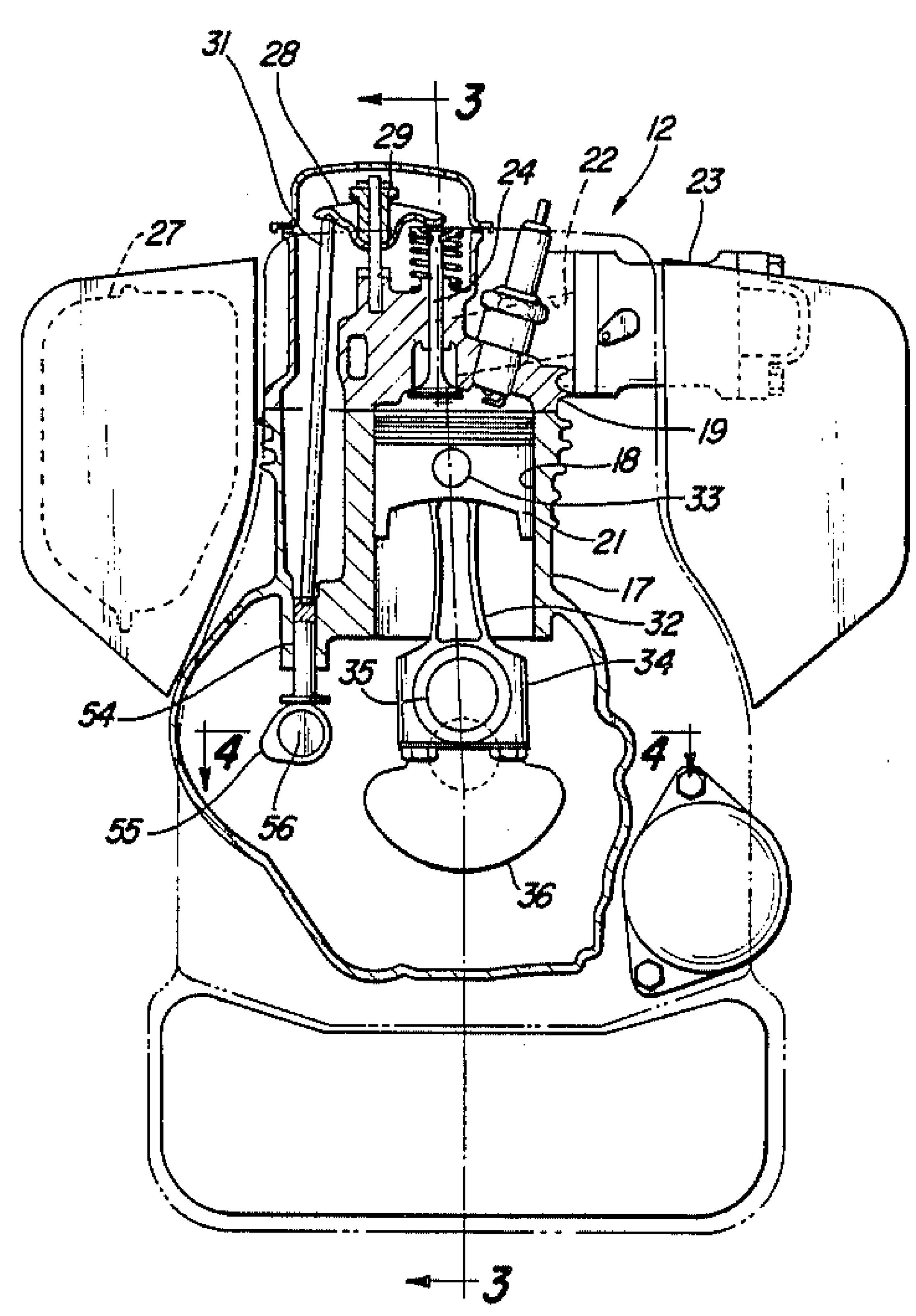
[57] **ABSTRACT**

A vertical shaft internal combustion engine particularly adapted for powering a rotary type lawn mower. The engine is provided with a baffled crankcase so as to minimize the adverse effects of oil "sloshing" within the crankcase while, at the same time, permitting flow between the baffles. In addition, an oil slinger arrangement is incorporated that is also baffled so as to reduce frothing in the crankcase to reduce aeration of the oil in the crankcase and also to direct the oil flow from the slinger.

20 Claims, 5 Drawing Sheets



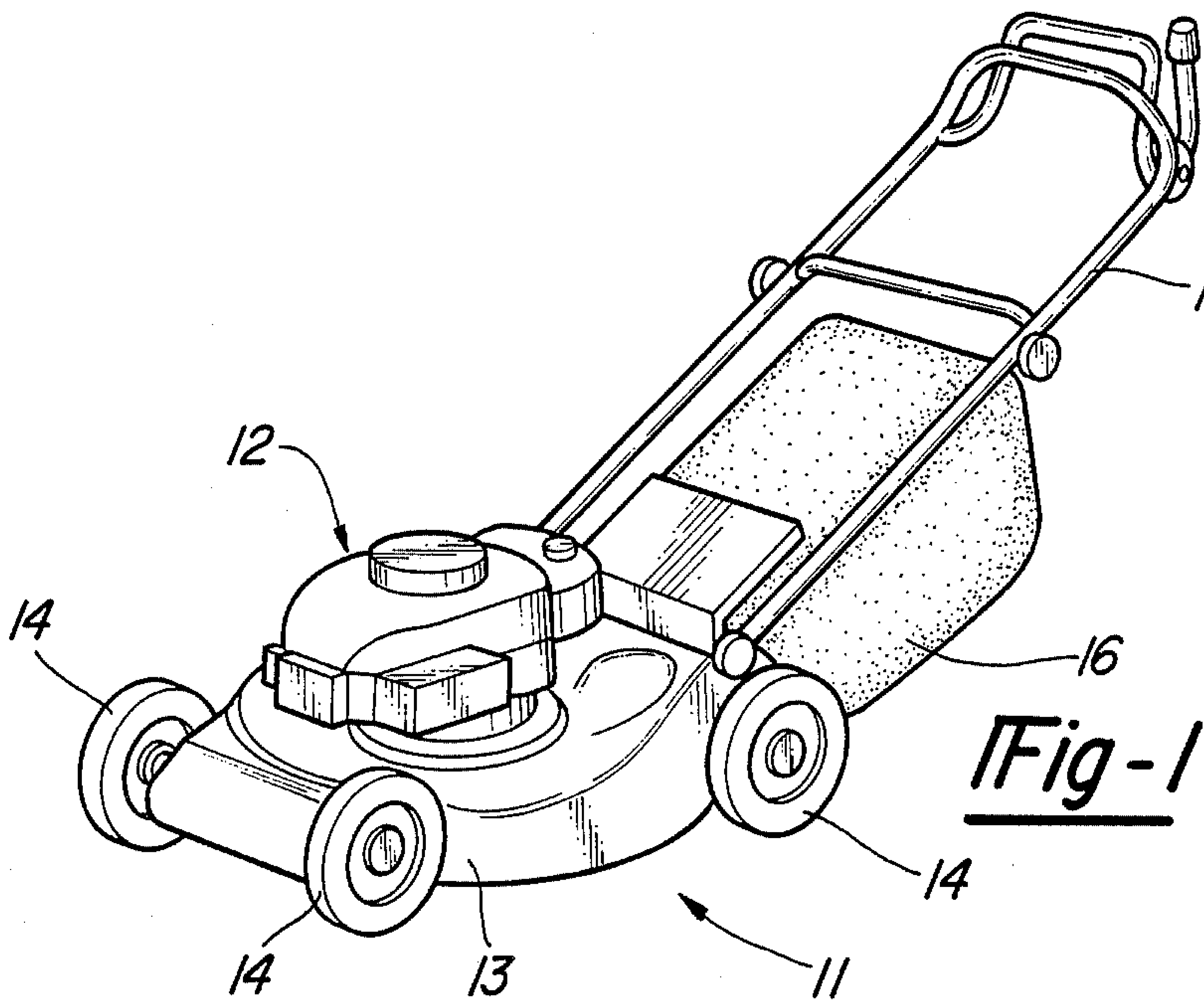


Fig-1

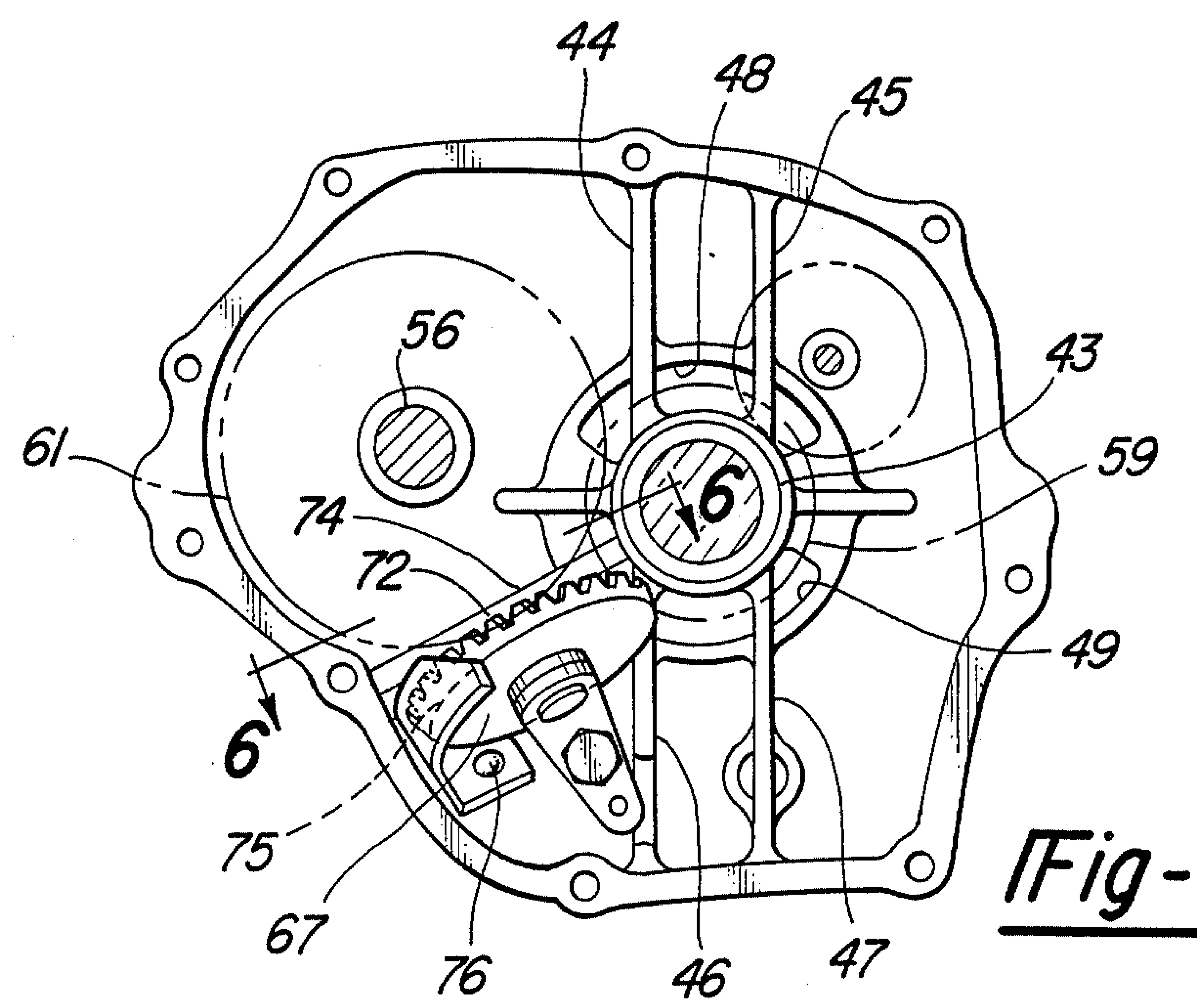


Fig-5

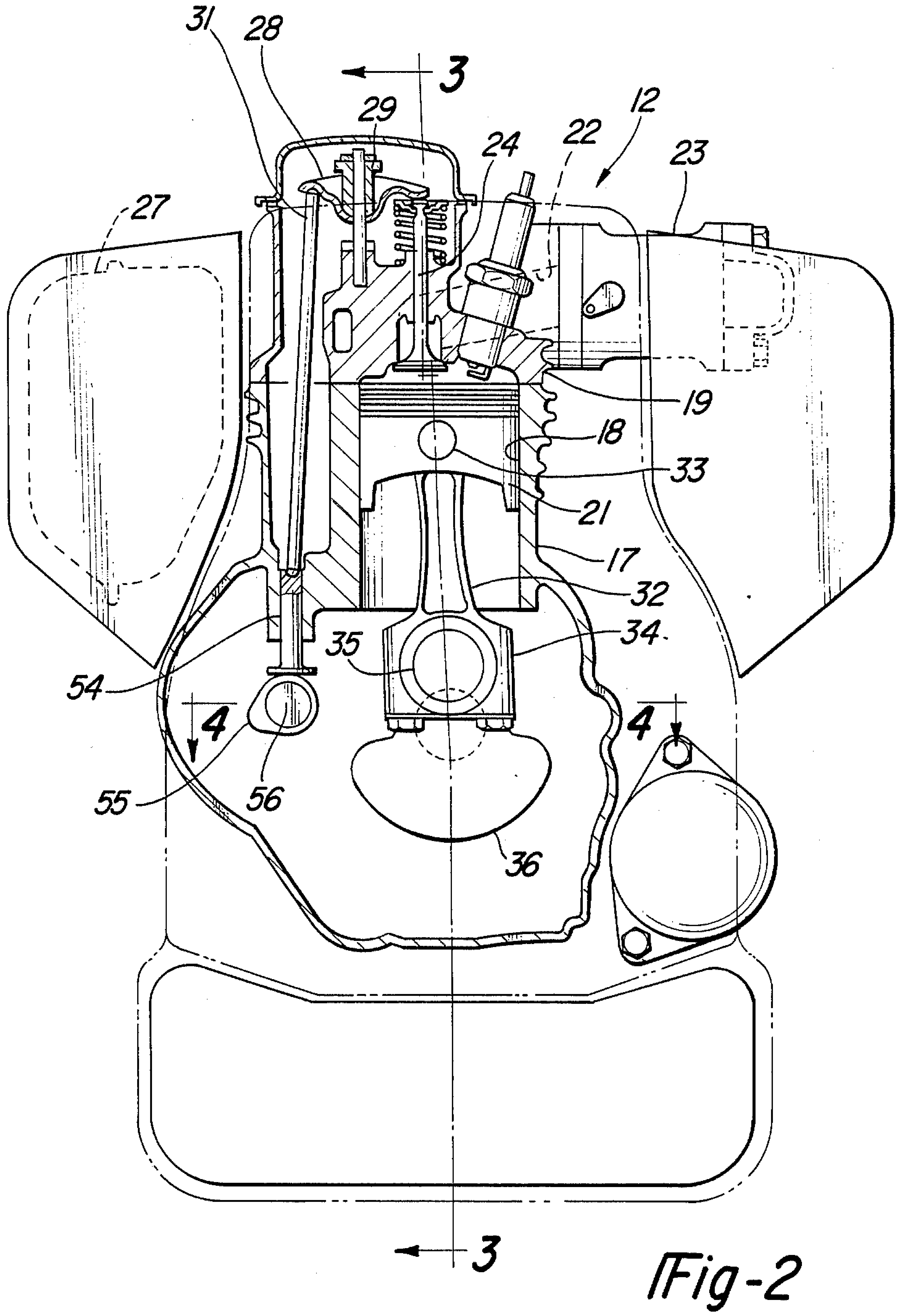


Fig-2

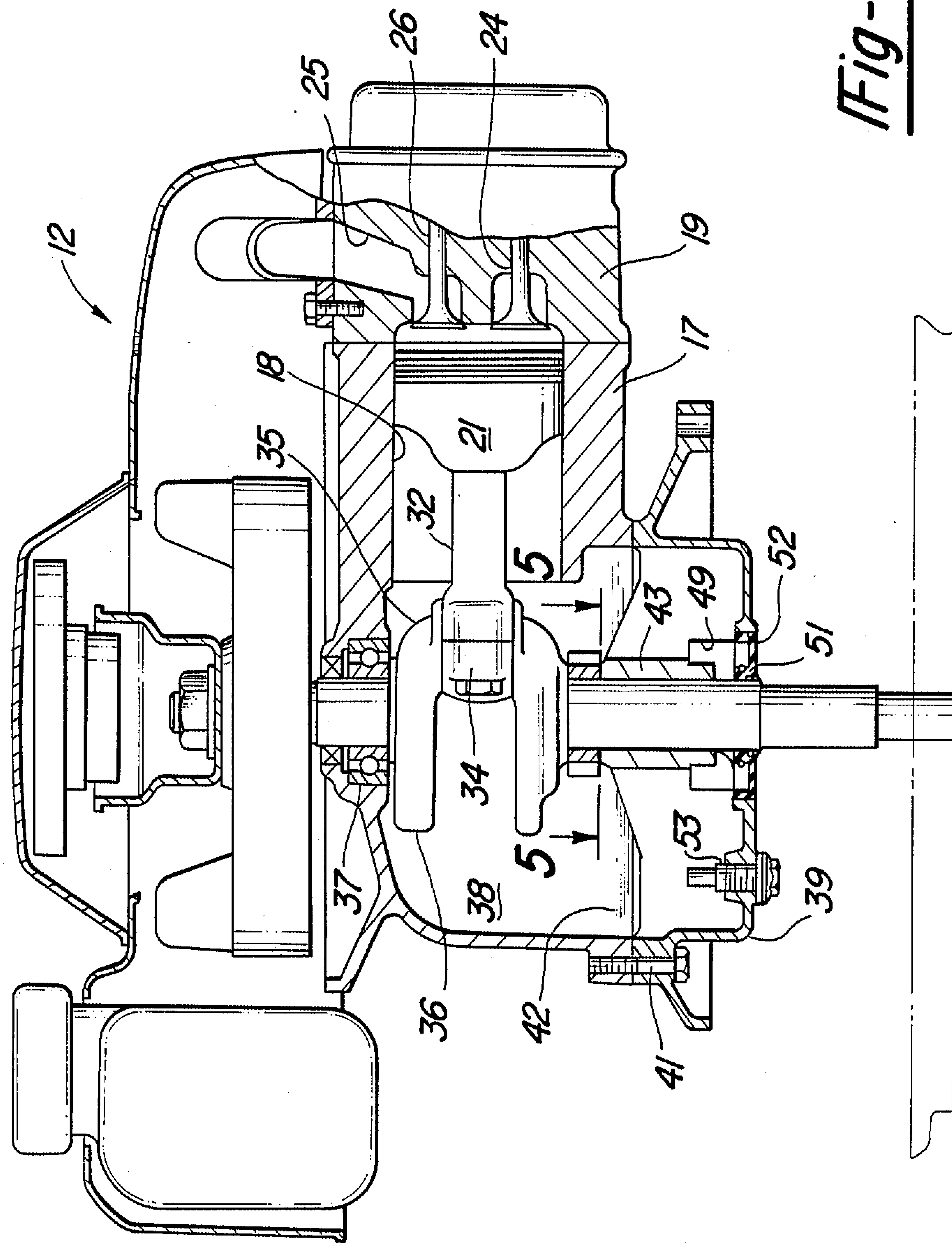


Fig-3

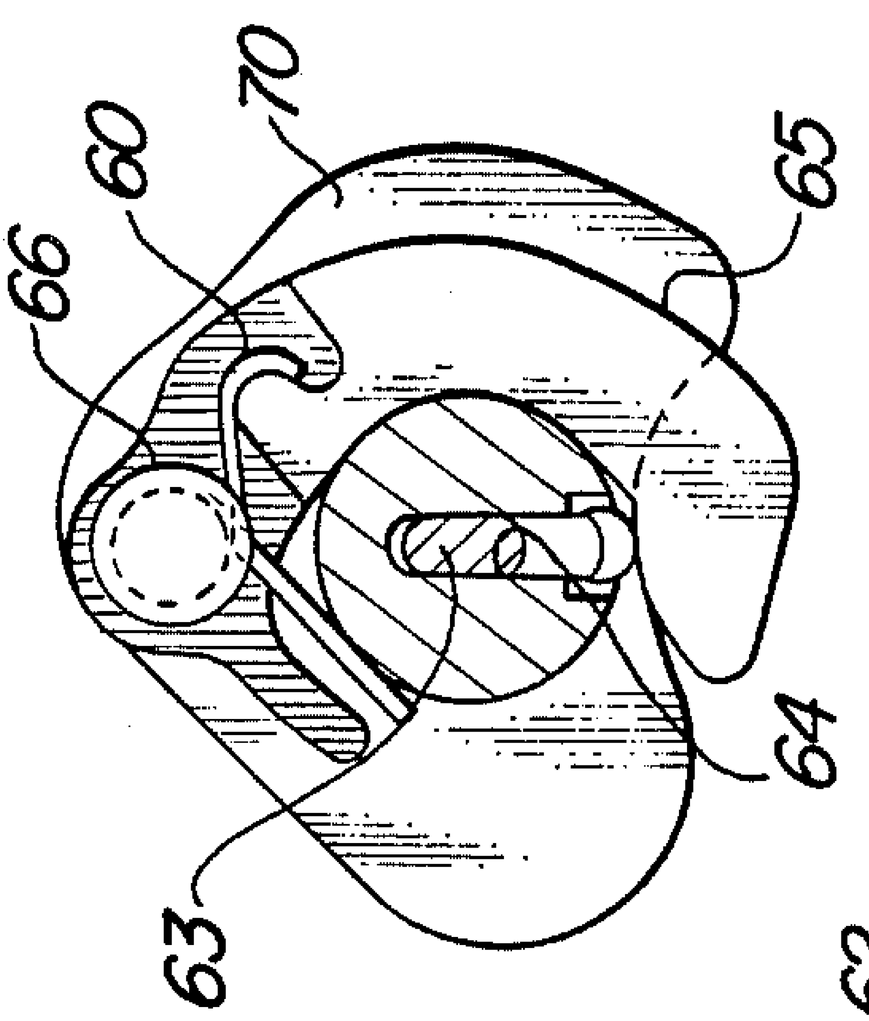

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Fig-8

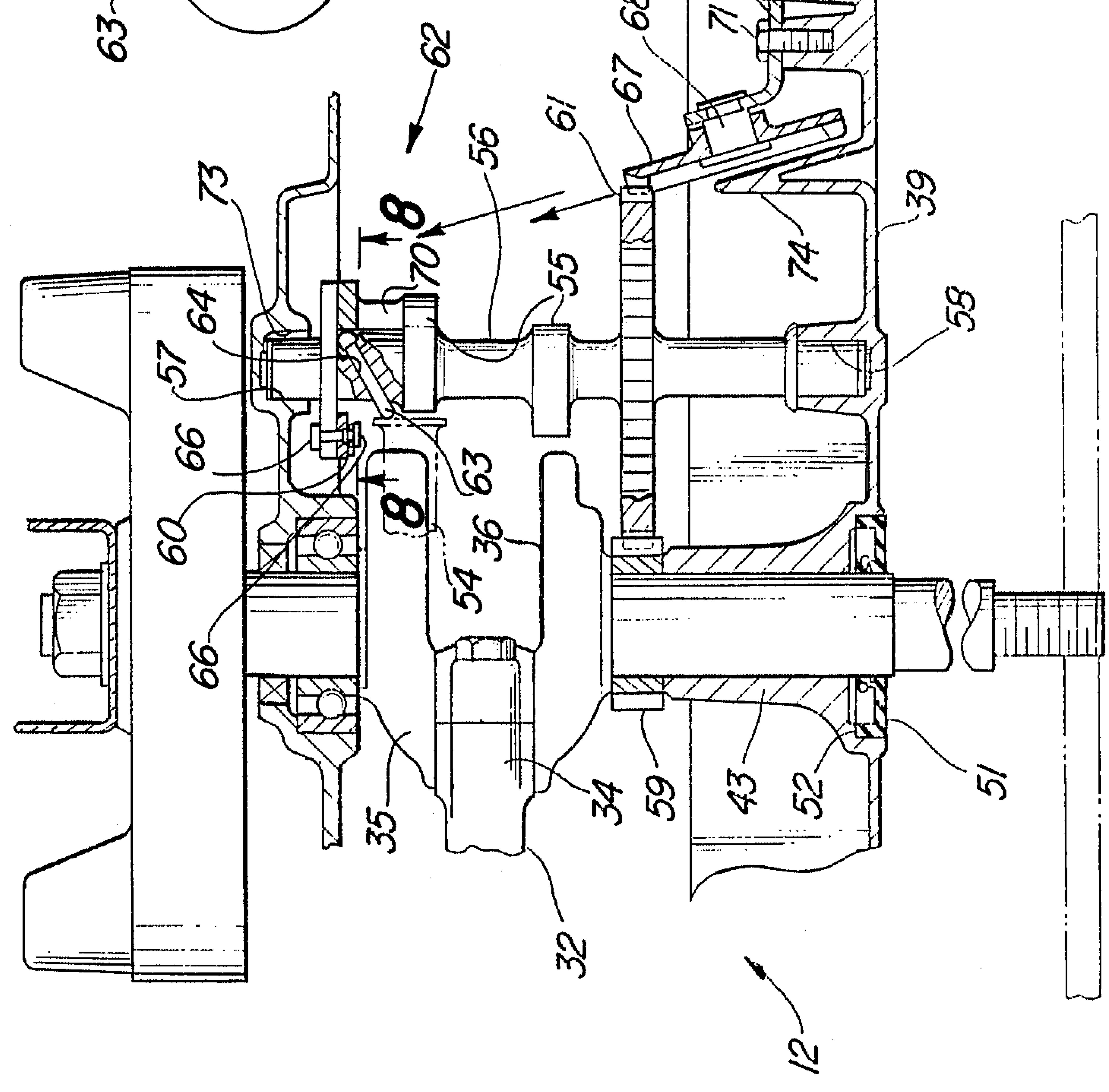
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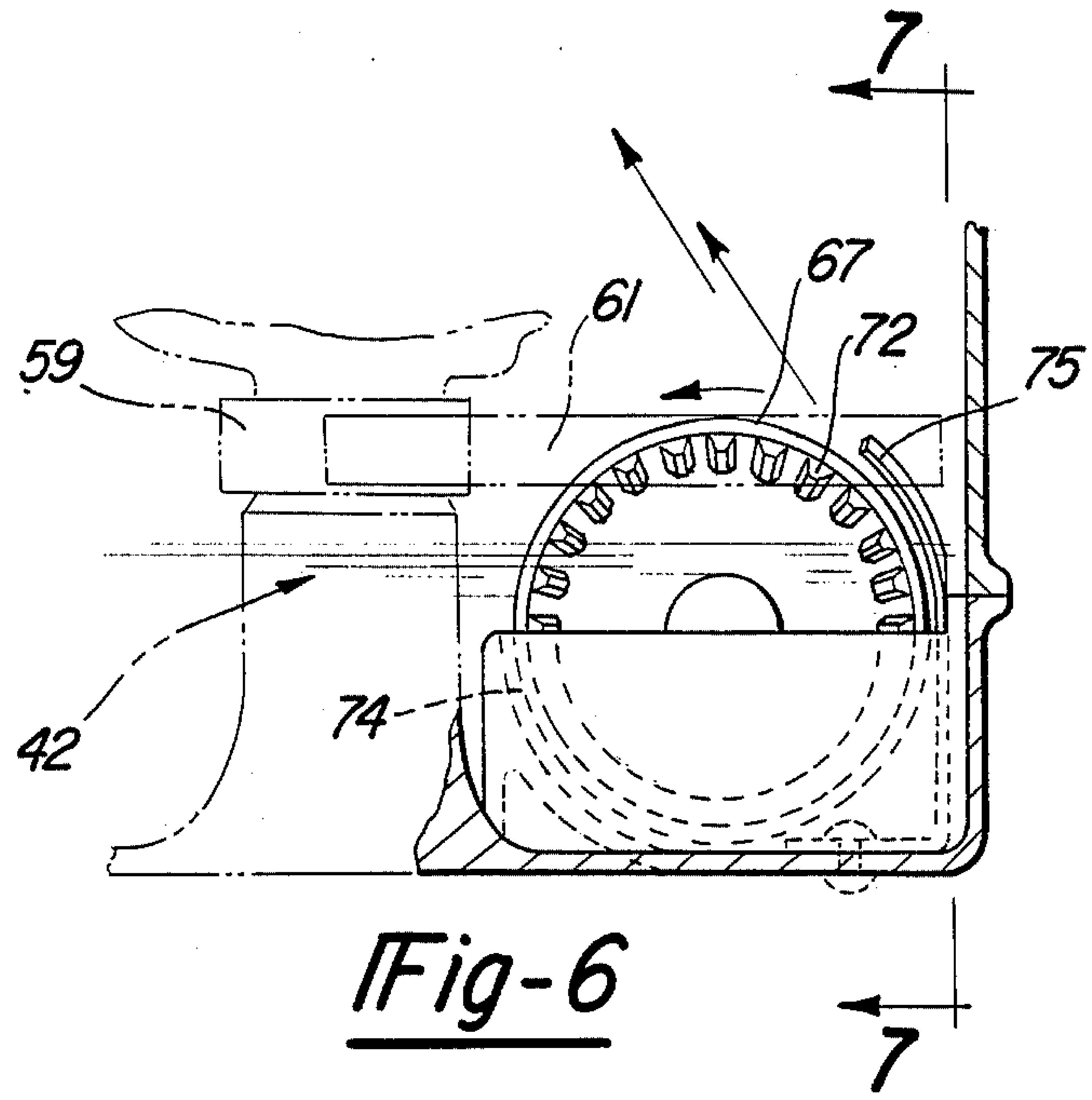
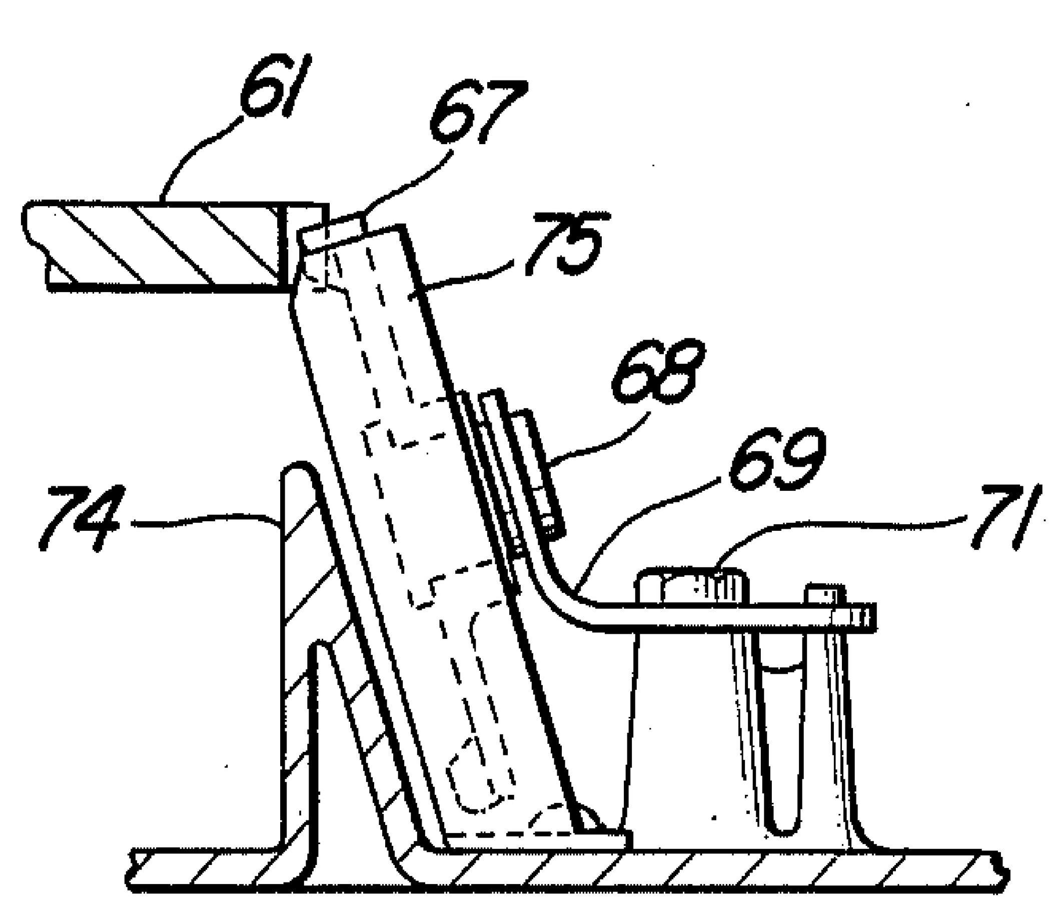
Fig-4



IFig-6



IFig-7

LUBRICATING SYSTEM FOR VERTICAL SHAFT ENGINE

BACKGROUND OF THE INVENTION

This invention relates to a lubricating system for a vertical shaft engine and more particularly to an improved lubricating system for use with a walk-behind lawn mower or similar implement.

In a large number of applications, an internal combustion engine is operated with its output shaft extending in a vertical direction. Examples of such applications are found in rotary lawn mowers wherein the grass is cut by a cutting blade that rotates about a vertically extending axis and is driven by an engine having its output shaft similarly disposed. Such an arrangement offers considerable utility because the engine output shaft can be directly coupled to the cutting blade shaft without the necessity of intervening transmissions or gear reduction units. When such an arrangement is employed, the output shaft passes through the center of the engine crankshaft. This presents certain problems in connection with the lubrication of the engine, particularly when the engine has a splash-type lubrication system.

Specifically, this type of orientation results in a crankcase that has relatively shallow height and a large cross-sectional area in a horizontally extending plane. As such, the depth of the lubricant in the crankcase can differ significantly when the engine is in motion and the "sloshing" of the lubricant can result in inadequate lubrication under these conditions.

It is, therefore, a principle object of this invention to provide an improved vertical shaft engine and lubricating system for such an engine.

It is another object of this invention to provide an improved arrangement for lubricating a vertical shaft engine.

It is yet a further object of this invention to provide an improved lubricating system for a vertical shaft engine wherein a splash-type lubrication system is employed.

In connection with splash lubricated internal combustion engines, it has been proposed to employ an oil slinger which is driven from the engine output shaft or an engine accessory shaft and which dips into the lubricant into the crankcase and throws it onto certain components of the engine to be lubricated. Although such an arrangement is effective in insuring adequate lubrication of all components of the engine with a splash-type system, there are certain disadvantages. First of all, the motion of the engine can cause the slinger to be immersed at different levels in the lubricant and the spray pattern will differ depending upon the degree of immersion. Furthermore, the operation of the slinger in the crankcase can tend to cause foaming of the lubricant in the crankcase that can adversely affect the lubrication of other components in the engine.

It is, therefore, a still further object of this invention to provide an improved a splash lubricating system of the type employing an oil slinger.

It is a yet further object of this invention to provide a baffling arrangement for an oil slinger that will control the direction of flow of the oil and will minimize the frothing of the oil in the crankcase.

SUMMARY OF THE INVENTION

A first feature of this invention is adapted to be embodied in a lubricating system for an internal combustion engine having an output shaft rotating about a generally vertically extending axis. A lubricant reservoir is defined at least in part by a lower wall of the engine which surrounds the engine output shaft and through which the output shaft passes for driving a driven element. The wall is formed with an upwardly extending baffle for dividing the lubricant reservoir into separate sections and for reducing "sloshing" of the lubricant within the lubricant reservoir. Oil passage means extend through the wall for permitting lubricant to flow through.

Another feature of the invention is adapted to be embodied in a lubricating system for an internal combustion engine having a generally horizontally disposed cylinder extending from a crankcase and a crankshaft journal for rotation within the crankcase about a generally vertically extending axis. An oil slinger is rotatable about an axis disposed at an angle to the horizontal and vertical and is driven by the crankshaft. The oil slinger axis is disposed for directing lubricant thrown by the slinger toward a component of the engine to be lubricated. In accordance with this feature of the invention, a baffle is contained within the crankcase and juxtaposed to the slinger for controlling the oil movement.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a walk-behind type of lawn mower powered by an internal combustion engine constructed in accordance with an embodiment of the invention.

FIG. **2** is an enlarged cross-sectional view taken along a horizontal plane showing the engine, with certain of the components being shown in phantom.

FIG. **3** is a cross-sectional view generally along the line **3—3** of FIG. **2**.

FIG. **4** is a cross-sectional view, on an enlarged scale taken generally along the line **4—4** of FIG. **2**.

FIG. **5** is a cross-sectional view taken generally along the line **5—5** of FIG. **3**.

FIG. **6** is a cross-sectional view taken generally along the line **6—6** of FIG. **5**.

FIG. **7** is a cross-sectional view taken along the line **7—7** of FIG. **6**.

FIG. **8** is a cross-sectional view taken along the line **8—8** of FIG. **4**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

Referring first to FIG. **1**, a walk-behind lawn mower of the rotary type is identified generally by the reference numeral **11**. The lawn mower **11** illustrates a typical environment in which the invention may be employed. The invention relates particularly to an internal combustion engine **12** that is utilized for operating the lawn mower **11**. Although the invention is described in conjunction with a rotary-type lawn mower, it is to be understood that the invention is directed primarily toward the lubrication system of the engine **12** and that the invention has particular utility in a wide variety of other applications. However, the invention is particularly useful in connection with applications wherein the engine **12** is disposed so that its output shaft rotates about a generally vertically extending axis.

The lawn mower **11** further includes a main body portion **13** that houses a rotary cutting blade (not shown) that rotates about a vertically extending axis.

The cutting blade is rotatably coupled to the output shaft of the engine **12** in a known manner.

Four wheels **14** are journaled at the corners of the housing **13** so that the mower **11** may be moved along the ground. A handle **15** is provided so that an operator can stand behind and manipulate the mower **11**. In the illustrated embodiment, the mower **11** is of the rear-discharge type and a catcher bag **16** is supported beneath the handle assembly **15** for catching the rearwardly thrown grass clippings.

Referring now in detail to the remaining figures of the drawings and initially to FIGS. **2** through **4**, the construction of the engine **12** and specifically its lubrication system will be described.

The engine **12** is comprised of a cylinder block **17** that is formed with one horizontally disposed cylinder bore **18**. A cylinder head **19** is affixed to the cylinder block **17** in a known manner and closes the end of the cylinder bore **18** above a piston **21** that is supported for reciprocation within the cylinder bore **18**. An intake port **22** extends through the cylinder head **19** from a carburetor **23** which delivers a fuel/air charge to the intake port **22** in a known manner and terminates at an intake valve **24**. In a similar manner, an exhaust port **25** extends through the cylinder head **19** from an exhaust valve **26** and communicates with an externally positioned muffler **27** for silencing and discharging the exhaust gases to the atmosphere.

The intake and exhaust valves **24** and **28** are operated by means of respective rocker arms **28** that are journaled on individual pivot shafts **29** carried by the cylinder head **19**. Push rods **31** extend through the cylinder head **19** and cylinder block **17** and operate the rocker arms **28** for opening and closing the valves **24** and **26** in a known manner.

A connecting rod **32** is pivotally connected at one end to the piston **21** by means of a piston pin **33**. The lower or big end **34** of the connecting rod **32** is journaled on a throw **35** of a crankshaft **36**. The crankshaft **36** is journaled for rotation about a generally vertically extending axis by means which include an upper bearing **37** that is supported in the cylinder block **17** in a known manner.

The crankshaft **35** rotates in a crankcase chamber **38** which is formed in part by the cylinder block **17** and by means of a closure plate **39** that is affixed to the underside of the cylinder block **17** in a suitable manner as by bolts **41**. The closure plate **39** and a portion of the cylinder block **17** and specifically the portion of the cylinder block **17** which defines the crankcase chamber **38** also defines a lubricant reservoir in which lubricant is filled to a level, indicated by the line **42**.

Referring now additionally to FIG. **5**, the lower plate **39** is formed with an elongated journal section **43** that forms an elongated bearing for the lower end of the crankshaft **35**. The journal portion **43** extends from immediately adjacent the lower end of the plate **39** upwardly to a point slightly above the lubricant level **42**. In order to provide rigidity for the bearing portion **43** and also so as to provide a baffling arrangement in the crankcase **38**, there are provided transversely extending ribs **44, 45, 46** and **47** which are all form integrally with the bearing portion **43** and the remainder of the plate **39**. To this end, the plate **39** may be formed conveniently as a casting.

It will be noted that the ribs **44, 45, 46** and **47** are disposed, at their upper ends, below the lubricant level **42** except immediately adjacent the bearing portion **43**. Hence, the lubricant can communicate throughout the crankcase chamber **38** above the ribs **44, 45, 46** and **47** but the ribs have sufficient height so as to reduce the "sloshing" of lubricant within the crankcase **38**. In addition, there are provided annular recesses or holes **48** and **49** that extend through the ribs **44, 45, 46** and **47** respectively so as to permit communication of the lubricant of the various chambers at an area at the lower portion of the ribs **44, 45, 46** and **47**. This will ensure free flow through the entire crankcase chamber **38** while preventing "sloshing". In addition, this exposes the lower end of the crankshaft **35** below the bearing portion **43** with the lubricant.

A suitable oil seal **51** is contained within an annular opening **52** formed at the lower end of the plate **39** so as to provide good oil sealing and the ensure against leakage of lubricant from the oil reservoir portion. A drain plug **53** is also provided in the lower wall so as to permit draining of the lubricant from the lubricant reservoir.

As has been noted, the intake and exhaust valves **24** and **26** are operated by rocker arms **28** and push rods **31**. The push rods **31** are, in turn, operated by means of tappets **54** (FIG. **2**) that are slidably supported within the cylinder block **17** and are engaged by lobes **55** of a camshaft **56**. The camshaft **56** is rotatably journaled in a upper bearing portion **57** formed in the cylinder block **17** and in a lower bearing portion **58** formed in the lower plate **39** (FIG. **4**). Hence, the camshaft **56** rotates about an axis that is parallel to the rotational axis of the crankshaft **36**. The camshaft **56** is driven at one-half of crankshaft speed by means of timing gears consisting of a first gear **59** that is affixed to the crankshaft **36** adjacent the bearing **43** and a second gear **61** that is either affixed to or formed integrally with the camshaft **56**.

The engine is provided with a decompression device, indicated generally by the reference numeral **62** (FIGS. **4** and **8**) for lifting the exhaust tappet **54** from the camshaft **56** under low speeds to reduce the compression in the engine and make the starting of it easier. The decompression device **62** includes a plunger **63** that is slidably supported in a transversely extending bore **64** of the camshaft **56** adjacent the lobe **55** that actuates the tappet **54** of the exhaust valve **26**. The plunger **63** is engaged by a centrifugal weight **65** that is journaled by a pivot pin **66** on the camshaft **56** and biased by a torsional spring **50** so as to cause the plunger **63** to extend when the engine is not running or is turning over only at low speeds and lift the exhaust valve tappet **54** slightly so as to reduce the compression. As the engine begins to run, the centrifugal weight **65** will move outwardly and the plunger **63** can withdraw under centrifugal force so as to permit normal operation of the exhaust valve **26** once the engine is running. The centrifugal weight **65** is guided by a lug **70** on the camshaft **56** so as to control the pivotal movement.

As has been previously noted, the engine **12** is provided with a splash lubrication system and this includes an oil slinger **67** that is supported for rotation about a shaft **68** carried by a bracket **69** that is affixed to the lower plate **33** by means of a bolt **71**. It should be noted that the oil slinger **67** is formed with gear teeth **72** that are enmeshed with the camshaft timing gear **61** for rotatably driving the slinger **67**. The axis defined by the shaft **68** is neither vertical nor horizontal but is inclined to the horizontal as clearly shown in FIG. **4**. The oil slinger **67** is disposed so that it will be immersed below the normal lubricant level **42** in the crankcase and will throw oil upwardly toward the decompression device

62, the upper end of the camshaft **56** and specifically its journal portion **57**. The journal portion **57** is formed with a recess **73** that is adapted to receive this thrown oil and permit it to trickle down the camshaft **56** so as to lubricate the lobes **55** and tappets **54**.

In order to prevent aeration of the lubricant in the crankcase **38** and to confine the flow of lubricant thrown by the slinger **67**, the lower wall **39** is provided with an upstanding baffle portion **74** that extends immediately adjacent the gear teeth **72** of the slinger **67** and terminates at approximately the rotational axis of the slinger. This baffle **74** will confine the direction of lubricant flow and will, as has been noted, reduce the aeration of the lubricant in the crankcase **38**. In addition, an oil guide plate **75** is affixed to the plate **39** by means of bolts **76** (FIG. 5) and extends around the oil slinger **67** from below the level of lubricant **42** to a point vertically upwardly so that the oil thrown by the slinger will be directed toward the camshaft bearing **57**. This baffle arrangement consisting of the wall **74** and guide plate **75** are very effective in directing the lubricant flow while elminating frothing in the crankcase.

It should be readily apparent from the foregoing description that a very effective lubricating system is provided for an engine having an output shaft rotatable about a vertically extending axis and for ensuring that the lubricant will be appropriately directed toward the components to be lubricated and also so that there will be minimum frothing from the oil in the crankcase.

In addition, there is the insurance that oil "sloshing" in the crankcase will be minimized without interfering with the complete flow of lubricant to the various components of the engine to be lubricated and while maintaining an adequate lubricant head.

Various changes and modifications may be made without departing from the spirit and scope of the invention, as defined by the appended claims.

We claim:

1. In a lubrication system for an internal combustion engine having an output shaft rotatable about a generally vertically extending axis, a lubricant reservoir defined at least in part by a lower wall of said engine surrounding said output shaft and through which said output shaft passes for driving a driven element, said lower wall being formed with an upwardly extending baffle for dividing said lubricant reservoir into separate sections and for reducing sloshing of lubricant within said lubricant reservoir, and oil passage means extending through said baffle for permitting lubricant to flow therethrough.

2. In a lubrication system for an internal combustion engine as set forth in claim **1** wherein the baffle is integrally formed with a bearing rotatably journaling the engine output shaft.

3. In a lubrication system for an internal combustion engine as set forth in claim **2** wherein the lower wall is formed with a pair of generally parallel baffles each integrally connected to the output shaft bearing.

4. In a lubrication system for an internal combustion engine as set forth in claim **3** wherein the oil passage means comprise circumferential recesses formed in a lower face of the lower wall adjacent the baffles.

5. In a lubrication system for an internal combustion engine as set forth in claim **1** wherein the baffle extends transversely across the reservoir.

6. In a lubrication system for an internal combustion engine as set forth in claim **5** wherein the baffle is formed integrally with the lower wall.

7. In a lubrication system for an internal combustion engine as set forth in claim **6** wherein the lower wall is formed with a pair of generally parallel baffles each integrally connected to the output shaft bearing.

8. In a lubrication system for an internal combustion engine as set forth in claim **7** wherein the oil passage means comprise circumferential recesses formed in a lower face of the lower wall adjacent the baffles.

9. In a lubrication system for an internal combustion engine as set forth in claim **8** wherein the baffles are integrally connected to a bearing formed by the lower wall and journalling the output shaft.

10. In a lubrication system for an internal combustion engine as set forth in claim **1** further including an oil slinger driven by the engine output shaft and immersed in the oil reservoir.

11. In a lubrication system for an internal combustion engine as set forth in claim **10** wherein the oil slinger rotates about an axis that is inclined to the horizontal and wherein the lower wall is formed with a further baffle adjacent the oil slinger.

12. In a lubrication system for an internal combustion engine as set forth in claim **11** further including a camshaft driven by the engine output shaft by means of a pair of timing gears, the oil slinger having a gear engaged with the camshaft timing gear for driving the oil slinger.

13. In a lubrication system for an internal combustion engine as set forth in claim **10** further including a baffle plate extending around a portion of the circumference of the oil slinger for directing the oil thrown thereby.

14. In a lubrication system for an internal combustion engine as set forth in claim **13** wherein the oil slinger rotates about an axis that is inclined to the horizontal and wherein the lower wall is formed with a further baffle adjacent the oil slinger.

15. In a lubrication system for an internal combustion engine as set forth in claim **14** further including a camshaft driven by the engine output shaft by means of a pair of timing gears, the oil slinger having a gear engaged with the camshaft timing gear for driving the oil slinger.

16. In a lubrication system for an internal combustion engine having a generally horizontaly disposed cylinder extending from a crankcase, a crankshaft journaled for rotation within said crankcase about a generally vertically extending axis, an oil slinger rotatable about an axis disposed at an angle to both the horizontal and the vertical and at least in part submerged in the lubricant in said crankcase, means for driving said oil slinger from said camshaft, said oil slinger axis being disposed for directing lubricant thrown by said slinger toward the upper end of said camshaft and a baffle contained within said crankcase and juxtaposed to said slinger for confining the oil movement within the crankcase.

17. In a lubrication system for an internal combustion engine as set forth in claim **16** wherein the baffle extends generally perpendicularly to the axis of rotation of the oil slinger.

18. In a lubrication system for an internal combustion engine as set forth in claim **17** wherein the baffle is formed integrally with the crankcase.

19. In a lubrication system for an internal combustion engine as set forth in claim **18** further including a circumferential baffle fixed within the crankcase extending partially around the circumference of the oil slinger for directing the oil thrown thereby.

20. In a lubrication system for an internal combustion engine as set forth in claim **16** further including a circumferential baffle fixed within the crankcase extending partially around the circumference of the oil slinger for directing the oil thrown thereby.

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